(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 742 227 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
14.03.2001 Bulletin 2001/11

(51) Int Cl.7: **C07F 17/00**, C08F 4/642, C08K 5/00, C08L 23/10

(21) Application number: **96112193.6**

(22) Date of filing: **09.10.1990**

(54) Hemiisotactic polypropylene as a plasticizer for syndiotactic or isotactic polypropylene

Hemi-isotaktisches Polypropylen als Weichmacher für syndiotaktisches oder isotaktisches Polypropylen

Polyproylène hémi-isotactique comme plastifiant pour polypropylène syndiotactique où isotactique

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

(30) Priority: **10.10.1989 US 419221**

(43) Date of publication of application:
13.11.1996 Bulletin 1996/46

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
90870177.4 / 0 423 101

(73) Proprietor: **FINA TECHNOLOGY, INC.**
Houston, Texas 77267-4412 (US)

(72) Inventor: **Ewen, John A.**
Houston, Texas 77058 (US)

(74) Representative: **Leyder, Francis et al**
c/o Fina Research S.A.
Dept. Brevets
Zone Industrielle C
7181 Seneffe (Feluy) (BE)

(56) References cited:
US-A- 4 829 125

- **MACROMLLECULES, vol. 18, 1985, WASHINGTON, XP002018525 G. DI SILVESTRO ET AL.: "Resolution of the Carbon-13 Nuclear Magnetic Resonance Spectrum of Hemiisotactis Polypropylene at the Decad and Undecad Level"**
- **JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, vol. 110, 1988, WASHINGTON, XP002018526 J. A. EWEN ET AL: "Syndiotactic Propylene Polymerizations with Group 4 Metallocenes"**

EP 0 742 227 B1

Printed by Jouve, 75001 PARIS (FR)

Description

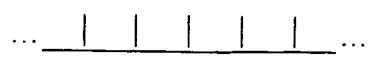
BACKGROUND OF THE INVENTION

[0001] FIELD OF THE INVENTION : This invention relates, generally, to hemiisotactic polypropylene as plasticizer for syndiotactic or isotactic polypropylene.

[0002] DESCRIPTION OF RELATED ART : Olefins, especially propylene, may be polymerized to form polyolefins in various forms : isotactic, syndiotactic and atactic.

Isotactic polypropylene contains principally repeating units with identical configurations and only a few erratic, brief inversions in the chain. Isotactic polypropylene may be structurally represented in a Fischer projection as

(1)

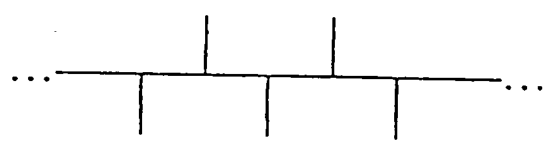


In Bovey's NMR nomenclature the isotactic structure is designated ... mmm ... since the five successive methyl groups are meso to each other, i.e., on the same side of the plane in a Fischer projection.

[0003] Isotactic polypropylene is capable of being a highly crystalline polymer with a high melting point and other desirable physical properties that are considerably different from the polymer in an amorphous (noncrystalline) state

[0004] A syndiotactic polymer contains principally units of exactly alternating stereoisomers and is represented in a Fischer projection by the structure:

(2)

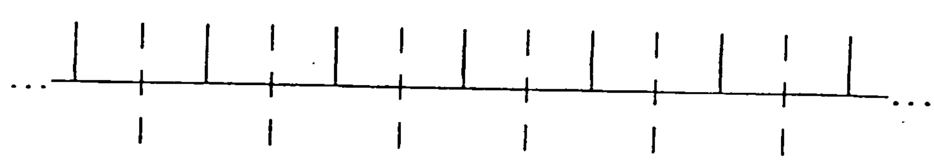


In Bovey's NMR nomenclature the syndiotactic structure is designated ...rrrr... since the five successive methyl groups are racemic to each other, i.e., on alternate sides of the plane in a Fischer projection.

[0005] A polymer chain showing no regular order of repeating unit configurations is an atactic polymer. In commercial applications, a certain percentage of atactic polymer is typically produced with the isotactic form.

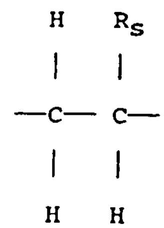
[0006] There are other variations in the form of polymer structure. Hemiisotactic or hemitactic polypropylene was disclosed in "Hemitactic Polypropylene: An Example of a Novel Kind of Polymer Tacticity" by M. Farina, G. Di Silvestro and P. Sozzani (Macromolecules, Vol. 15, 1451-1452, 1982). The structure of hemiisotactic polymers is represented in a Fischer projection as follows:

(3)



[0007] The monomeric unit of the polymer is of the following structure:

(4)



where R_s is a hydrocarbyl group or nonhydrocarbyl group. The second carbon atom in formula (6) is the asymmetric carbon atom, i.e., the one which does not have identical groups attached, hence "asymmetric".

[0008] The structure of the polymer is characterized by R_s groups attached to every other asymmetric carbon atom being on the same side of the principal polymer chain as represented in a Fischer projection and R_s groups attached to the remaining asymmetric carbon atoms being either on the same side or the opposite side of the R_s groups attached to every other asymmetric carbon atom. When R_s groups are on the same side of the principal polymer chain, the structure is isotactic. Since only every other one conforms to the isotactic structure, it is "hemi". The material is a noncrystalline polymer.

[0009] Polymerization of olefins is primarily with Ziegler-Natta catalysts. One family of Ziegler-Natta catalysts is Group IV metallocene compounds with methylaluminoxane as a cocatalyst. German patent application No. 2,608,863 discloses a catalyst system for the polymerization of ethylene consisting of bis(cyclopentadienyl)titanium dialkyl, an aluminum trialkyl and water. German patent application No. 2,608,933 discloses an ethylene polymerization catalyst system consisting of zirconium metallocenes of the general formula $(cyclopentadienyl)_nZrY_{4-n}$, wherein Y represents $R_1CH_2AlR_2$, $CH_2CH_2AlR_2$ and $CH_2CH(AlR_2)_2$ where R stands for an alkyl or metallo alkyl, and n is a number within the range 1-4; and the metallocene catalyst is used in combination with an aluminum trialkyl cocatalyst and water.

[0010] The use of metallocenes as catalysts in the copolymerization of ethylene and other alpha-olefins is also known in the art. U.S. Pat. No. 4,542,199 to Kaminsky, et al. discloses a process for the polymerization of olefins and particularly for the preparation of polyethylene and copolymers of polyethylene and other alpha-olefins. The disclosed catalyst system includes a catalyst of the formula $(cyclopentadienyl)_2MeRHal$ in which R is a halogen, a cyclopentadienyl or a C_1-C_6 alkyl radical, Me is a transition metal, in particular zirconium, and Hal is a halogen, in particular chlorine. The catalyst system also includes an alumoxane having the general formula $Al_2OR_4(Al(R)\text{-}O)n$ for a linear molecule and/or $(Al(R)\text{-}O)_{n+2}$ for a cyclic molecule in which n is a number from 4-20 and R is a methyl or ethyl radical. A similar catalyst system is disclosed in U.S. Pat. No 4,404,344.

[0011] U.S. Pat. No. 4,530,914 discloses a catalyst system for the polymerization of ethylene to polyethylene having a broad molecular weight distribution and especially a bimodal or multimodal molecular weight distribution. The catalyst system is comprised of at least two different metallocenes and an alumoxane. The patent discloses metallocenes that may have a bridge between two cyclopentadienyl rings with the bridge serving to make those rings stereorigid.

[0012] European Patent Publication No. 0185918 discloses a stereorigid, chiral zirconium metallocene catalyst for the polymerization of olefins. The application does not indicate that hafnium could be substituted for the zirconium and used to produce a useful polymer product. The bridge between the cyclopentadienyl groups is disclosed as being a linear hydrocarbon with 1-4 carbon atoms or a cyclical hydrocarbon with 3-6 carbon atoms.

[0013] European Patent Application 0-277-003 relates to work by Turner on a catalyst prepared by a protonation method. A bis(cyclopentadienyl) metal compound is combined with a compound having a cation capable of donating a proton and an anion having a plurality of boron atoms. For example, the following reaction illustrates the invention.

bis(cyclopentadienyl)hafnium dimethyl +

N,N-dimethylanilinium bis(7,8-dicarbaundecaborato)

cobaltate(III) $\rightarrow$ $[Cp_2HfMe][B] + CH_4$ + N,N-dimethylaniline

where [B] is 7,8-dicarbaundecaborane.

[0014] European Patent Application 0-277-004 also relates to work by Turner on a catalyst prepared by a protonation method. A bis(cyclopentadienyl) metal compound is combined with an ionic compound having a cation which will irreversibly react with a ligand on the metal compound and an anion having a plurality of lipophilic radicals around a metal or metalloid ion. For example, the following reaction illustrates the invention:

tri(n-butyl) ammonium tetra (pentafluorophenyl) boron + bis (cyclopentadienyl

zirconium dimethyl $\Rightarrow$ $[Cp_2ZrMe]\,[BPh_4] + CH_4 + (n\text{-}Bu)_3N$.

Syndiospecific propylene polymerization with an isopropyl (cyclopentadienyl 1-fluorenyl) hafnium dichloride metallocene catalyst yielding crystalline polymer in high yields is disclosed in "Syndiospecific Propylene Polymerizations with Group 4 Metallocenes", J. Am. Chem. Soc., Vol. 110, pp. 6255-6256, 1988.

[0015] A system for the production of isotactic polypropylene using a titanium or zirconium metallocene catalyst and an alumoxane cocatalyst is described in "Mechanisms of Stereochemical Control in Propylene Polymerization with Sobuble Group 4B Metallocene / Methylalumoxane Catalysts", J. Am. Chem. Soc., Vol. 106, pp. 6355-64, 1984. The article shows that chiral catalysts derived from the racemic enantiomers of ethylene-bridged indenyl derivatives form isotactic polypropylene by the conventional structure predicted by an enantiomorphic-site stereochemical control model. The meso achiral form of the ethylene-bridged titanium indenyl diastereomers and achiral zirconocene derivatives, however, produce polypropylene with a purely atactic structure.

[0016] US-A-4 829 125 discloses thermoplastic resin compositions comprising crystalline polypropylene and dioctyl phthalate as a plasticizer.

SUMMARY OF THE INVENTION

[0017] In accordance with the present, hemiisotactic polypropylene is produced with a metallocene compound having a general formula of

$$R''(CpR_n)(CpR'_m)MHal_2 \qquad (5)$$

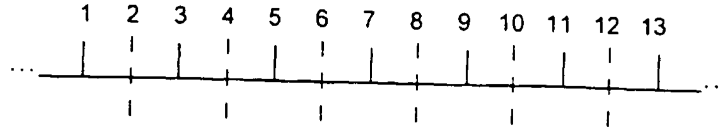
where each R and R' is a hydrocarbyl radical having from 1-20 carbon atoms, is the same or different and is selected such that CpR'm is a sterically different ring from CpRn resulting in a lack of bi-lateral symmetry for the compound, R" is a structural bridge imparting stereorigidity to the compound, M is a Group 4 metal, n is from 0 to 4, m is from 0 to 4 and Hal is a halogen. One example of such a compound is isopropylidene (3-methylcyclopentadienyl-1-fluorenyl)zirconium dichloride. This compound is a bridged, metallocene compound having dissimilar cyclopentadienyl groups and no bi-lateral symmetry.

[0018] One use for these compounds is in a metallocene catalyst system. The metallocene compounds defined above can be activated as catalysts by any known method of metallocene catalyst preparation

[0019] The polymer produced with the catalyst of this invention has the structure termed "hemiisotactic". Hemiisotactic polypropylene is characterized by every other methyl group being on the same side of the principal polymer chain as represented by a Fischer projection. The remaining methyl groups can be either on the same side or the opposite side of the principal polymer chain.

[0020] Propagation of the polymer chain results from head-to-tail linkage of the propylene monomer units in such a way the following structure is formed:

(6)



In this Fischer projection representation the odd numbered methine units are meso with respect to each other and the even numbered methine carbons have random steric configurations. Hemiisotactic polypropylene is noncrystalline due to the disorder and irregularity of these random groups. Hemiisotactic polypropylene is used as a plasticizer for syndiotactic or isotactic polypropylene.

DESCRIPTION OF THE INVENTION :

[0021] A metallocene compound which is a catalyst precursor for a catalyst is used to produce polymers termed hemiisotactic. The metallocene compound is changed to a metallocene catalyst with an ionizing agent which converts the neutral metallocene compound to a metallocene cation which operates as a catalyst. The ionizing agent can be a cocatalyst compound such as methylaluminoxane (MAO).

[0022] A preferred application of the invention is in the hemiisotactic polymerization of propylene which may be characterized in terms of the following formula .

$$(7) \qquad CH_2{=}CH{-}R_s$$

wherein R_s is a methyl group.

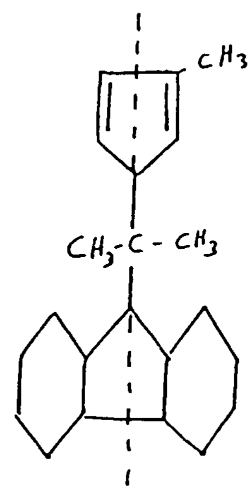
[0023] The catalyst used to produce hemiisotactic olefins is from a metallocene compound having a general formula of

$$(8) \qquad R''(CpR_n)\,(CpR'_m)MHal_2$$

where Cp is cyclopentadienyl or substituted cyclopentadienyl, each R and R' is a hydrocarbyl radical having from 1-20 carbon atoms and is the same or different and is selected such that CpR'_m is a sterically different ring from CpRn resulting in a lack of bi-lateral symmetry for the compound, R" is a structural bridge imparting stereorigidity to the compound, M is a Group 4 metal, preferably titanium, zirconium or hafnium, n is from 0 to 4, m is from 0 to 4 and Hal is a halogen, preferably chlorine.

[0024] The lack of bi-lateral symmetry for the compound is defined as the condition in which a metallocene compound having one non-cyclopentadienyl coordination site has no substituents or one or more substituents on one side of the cyclopentadienyl rings both above and below the coordination site and one or more substituents on the other side of the cyclopentadienyl rings either above or below the coordination site. One example of such a compound is isopropylidene(3-methylcyclopentadienyl -1-fluorenyl)zirconium dichloride, abbreviated $iPr(3MeCp\text{-}1\text{-}Flu)ZrCl_2$. An illustration of the ligand of this compound are shown below:

(9)



The lack of bi-lateral symmetry is illustrated by the right side of the drawing being different from the left because one methyl group is on the right side of one cyclopentadienyl ring and no substituents are on the left side of the same cyclopentadienyl ring.

[0025] The $iPr(3MeCp\text{-}1\text{-}Flu)ZrCl_2$ compound was prepared by cracking the methylcyclopentadiene dimer, preparing 3,6,6-trimethylfulvene, bridging the two cyclopentadiene compounds with an isopropylidene bridge and forming a coordination compound with zirconium and chlorine. Final reactions were carried out in tetrahydrofuran (THF) and in methylenedichloride ($MeCl_2$), also known as dichloromethane. Use of $MeCl_2$ allows the iPr(3MeCp-1-Flu)$ZrCl_2$ to be isolated in pure form.

[0026] Polymerization of the olefin is accomplished by any of the known means for polymerization of olefins with metallocene catalysts, for example polymerization in bulk, slurry or gas phase. For polypropylene, polymerization temperatures range from -80°C to 150°C, preferably 25°C to 90°C and most preferably from 50°C to 80°C

[0027] The noncrystalline hemiisotactic polypropylene has use as a plasticizer for syndiotactic or isotactic polypropylene. A plasticizer is a material incorporated in a plastic to increase its workability and its flexibility or distensibility. The addition of a plasticizer may lower the melt viscosity, the temperature of the second-order transition, or the elastic modulus of the plastic. The plastic and plasticizer are intimately mixed which is most commonly done by heating until the plastic has dissolved into the plasticizer of vice versa. Alternatively, the plastic and plasticizer are mixed by dissolution in a common solvent without heat followed by removal of the solvent by evaporation.

[0028] Hemiisotactic polymer is noncrystalline and with its partial stereoregular structure would have properties of a plasticizer. A specific example of a hemiisotactic polymer as a plasticizer is a reactor blend of hemiisotactic polypropylene and syndiotactic polypropylene made by polymerizing propylene simultaneously with both iPr(3MeCp-1-Flu) $ZrCl_2$ and isopropylidene (cyclopentadienyl -1-fluorenyl)zirconium dichloride, abbreviated iPr(Cp-1-Flu)$ZrCl_2$, or any other syndiospecific catalyst precursor. A reactor blend of hemiisotactic and isotactic polypropylene is possible by polymerizing propylene simultaneously with both iPr(3MeCp-1-Flu)$ZrCl_2$ and ethylenebis(tetrahydroindenyl)zirconium dichloride, abbreviated $Et(IndH_4)_2ZrCl_2$, or any other isospecific catalyst precursor. The amount of hemiisotactic polypropylene in mixture with isotactic or syndiotactic polypropylene can range from 1-90% by weight, depending on desired physical properties of the plasticized plastic. Preferably, the amount of hemiisotactic polypropylene in mixture with isotactic or syndiotactic polypropylene ranges from 5-50 % by weight. Most preferably, the amount of hemiisotactic polypropylene in mixture with isotactic or syndiotactic polypropylene is approximately 10% by weight.

[0029] The invention having been generally described, the following examples are given as particular embodiments of the invention and to demonstrate the practice and advantages thereof. It is understood that the examples are given by way of illustration and are not intended to limit the specification or the claims to follow in any manner.

EXAMPLE I

A. Preparation of 3,6,6,-trimethylfulvene

[0030] 150 ml of methylcyclopentadiene dimer was fractionally distilled from 100 ml of mineral oil and at 62°C and collected at 0°C. 500 mmol of methyl lithium (1.4M; diethylether) were added, dropwise, to a mixture of 500 mmol of freshly distilled methylcyclopentadiene and 137 ml of dry acetone at 0°C. The solution was stirred for 1 hour at 25°C. 8g (85% yield) of 3,6,6-trimethylfulvene were recovered from the organic layer by vacuum distillation after an extraction with 100 ml of saturated, aqueous NH_4Cl and drying over $MgSO_4$.

B. Preparation of iPr(3-MeCp-1-Flu)

[0031] One mole of 3,6,6-trimethylfulvene was dissolved in 100 ml THF and added, dropwise, to cold (-78°C) solution containing 1 mol of the lithium salt of the fluorenyl anion in approximately 100 ml THF and 714 ml of diethyl ether The mixture was warmed to room temperature. 18 g of white powder were obtained from the organic layer as a single isomer by extracting with aqueous NH_4Cl, drying over $MgSO_4$, filtering concentrating under vacuum to an oil, dissolving in chloroform, precipitating and washing with excess methanol. ^1H NMR CD_2Cl_2, int. ref. Me_4Si delta = 0 ppm: 7.7d, 7.3t, 7.2d and 7.1t (8) (Flu C6 rings); 6.5t and 5.6d (2) (Cp vinyl); 4.1s (1) (Flu C5 ring methine); 2.95s (2) (Cp methylene); 2.2d (3) (Cp methyl); 1.0s (6) (isopropyl methyl). (1 stereoisomer: The Cp methylene signal appears as a singlet because the methylene group is alpha to both the iPr bridge and the Cp methyl).

C1. Preparation of isopropylidene(3-methylcyclopentadienyl -1-fluorenyl)zirconium dichloride in methylene chloride

[0032] 2 equivalents of methyllithium (1.4 M in diethylether) were added, dropwise, at -78°C to 5 g of isopropylidene (3-methylcyclopentadiene-1-fluorene) dissolved in 100 ml THF, warmed to 25°C, and stirred for 12 hours. The red dilithio salt was isolated by evaporating the solvents under vacuum and then purified by washing with two 150 ml portions of dry, deoxygenated pentane that were cannulated away in term. The dianion was dissolved in methylene chloride at -78°C and an equivalent of $ZrCl_4$, slurried in 125 ml CH_2Cl_2 at -78°C, was rapidly cannulated into the flask containing the soluble dianion. The stirred mixture was warmed slowly to 25°C and stirred for 12 hours. A white solid was filtered off. 3 g of a moderately air sensitive, orange powder were obtained by concentrating the methylene chloride under vacuum, cooling the -20°C for 12 hours and cannulating the supernatant away. The product was purified by recrystallizing it from methylene chloride. $ZrCl_2C_{22}H_{20}$ requires C, 59; H, 4.5 Found. C, 56, H, 4.4 ^1H NMR (delta, ppm) CD_2Cl_2, int. ref. TMS delta = 0 ppm: 8.15-8.10 2d (2), 7.67-7.78 2d (2), 7.55-7.48 2t (2), 7.27-7.21 m (2) (Flu C6 rings), 5.93 t (1), 5.63 t (1), 5.42 t (1) (Cp vinyl); 2.4 d (6) (isopropyl methyl). 2.0 s (3) (Cp methyl).

C2. Preparation of isopropylidene(3-methylcyclopentadiene -l-fluorenyl)zirconium dichloride in THF

[0033] 34 mmol methyllithium in diethyl ether (1.4M) were added, dropwise, at 25°C, with stirring, to 5 gms of iPr [3-methylcyclopentadienyl-l-fluorene] ligand, then dissolved in 75 cc's THF which was contained in a round bottom flask equipped with a sidearm and dropping funnel. The dark orange/red solution was stirred for several hours after gas evolution had ceased. 6.41 gms of $ZrCl_4$·2 THF were dissolved in 100 ml of THF at 40°C. The dianion was cannulated into the flask containing the $ZrCl_4$·2 THF at 25°C. The mixture was stirred for 18 hours. The solution was then cannulated into a flask and cooled to -20°C to obtain a crystalline product. Alternatively, the THF was evaporated under vacuum. 5 mg of the LiCl/iPr[3MeCp-l-Flu]$ZrCl_2$ mixture was added to MAO for a polymerization test.

EXAMPLE II

[0034] 1.4 cc of methylaluminoxane (MAO) were mixed with 5 mg of iPr(3MeCp-l-Flu)$ZrCl_2$ prepared in THF as in Example I and dissolved in 10-20 ml of toluene. The MAO was 37 weight percent (Scherring). 1.2 liter of propylene was added to the reactor. The mixture was stirred for 10 minutes. Reactor temperature was set at 60°C.

[0035] The catalyst solution was added to a 50 ml stainless steel bomb. 200 ml of propylene was pumped through the bomb into the reactor. The contents of the reactor were agitated for 60 minutes.

[0036] The reaction product was dried in a vacuum. The polymer was weighed and analyzed for molecular weight distribution. The results are shown in Table I.

EXAMPLE III

[0037] The procedure of Example II was repeated using 1.4 cc of MAO, 1.2 l of propylene, 5 mg of iPr(3MeCp-l-Flu) $ZrCl_2$, a reaction temperature of 30°C and a run time of 60 minutes. The results are shown in Table I.

EXAMPLE IV

[0038] The procedure of Example II was repeated using 1.4 cc of MAO, 1.2 l of propylene, 5 mg of iPr(3MeCp-l-Flu) $ZrCl_2$ prepared in $MeCl_2$ as in Example I, a reactor temperature of 65°C and a run time of 60 minutes. The results are shown in Table I.

[0039] A C-13 NMR spectra was obtained for the polymer from this run. The probability of the occurrence of a particular sequence of meso and racemic polymer structures for hemiisotactic polypropylene was calculated based on the method in "Hemitactic Polypropylene: An Example of a Novel Kind of Polymer Tacticity". The results for the calculated versus the observed values as a function of the relative intensity of the NMR spectra are shown in Table II.

EXAMPLE V

[0040] 5.0 cc of MAO were mixed with 5 mg of iPr(3MeCp-l-Flu)$ZrCl_2$ prepared in $MeCl_2$ as in Example I above and dissolved in 10-20 ml of toluene. The MAO was 10 weight percent (Scherring). 1.4 l of propylene was added to the reactor. The mixture was stirred for 10 minutes. Reactor temperature was set to 60°C.

[0041] 0.4 mg of isopropylidene(cyclopentadienyl -l-fluorenyl)zirconium dichloride, abbreviated iPr(Cp-l-Flu)$ZrCl_2$, was dissolved separately in 10-20 ml of toluene. The two catalyst solutions were mixed together and added to a 50 ml stainless steel bomb. 200 ml of propylene was pumped through the bomb into the reactor. The contents of the reactor were agitated for sixty minutes.

[0042] The reaction product was dried in a vacuum. The polymer was weighed and analyzed for melting point. The results are shown in Table I.

[0043] All general synthetic procedures were performed under an inert atmosphere using a Vacuum Atmospheres glovebox or Schlenk techniques. Toluene, pentane and tetrahydrofuran solvents were distilled under nitrogen from purple sodium/benzophone-ketyl. Dichloromethane was distilled from fresh calcium hydride under nitrogen.

[0044] The following results are from the experimental runs described above using the method of the present invention.

TABLE I

Example	Metallocene Compound mg	MAO cc	Propylene L	T, °C
	iPr(3MeCp-1-Flu)$ZrCl_2$			
2	5	1.4	1.2	60
3	5	1.4	1.2	30
4	5	1.4	1.2	65
	iPr(3MeCp-1-Flu)$ZrCl_2$/ iPr(Cp-1-Flu)$ZrCl_2$			
5	5/0.4	5.0	1.4	60

Example	t, min.	Yield g	M_w/M_n
2	60	184	1.9
3	60	32	
4	60	297	3.4
5	60	162	

TABLE II

Sequence	Calculated	Observed
mmmm	0.15	0.14
mmmr	0.11	0.12
rmmr	0.07	0.06
mmrr	0.25	0.21
xmrx	0.00	0.05
mrmr	0.00	0.00
rrrr	0.23	0.19

TABLE II (continued)

Sequence	Calculated	Observed
rrrm	0.14	0.14
mrrm	0.06	0.08

[0045] This invention has taken a known syndiospecific catalyst precursor with bi-lateral symmetry and added a methyl group on one of the cyclopentadienyl groups to eliminate the bi-lateral symmetry. Such catalyst produces a structure of polypropylene termed hemiisotactic due to every other methyl group of the polypropylene being above the plane in a Fischer projection. Hemiisotactic polypropylene is noncrystalline and can be used as a plasticizer with syndiotactic and isotactic polypropylene.

[0046] Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

Claims

1. Composition comprising :

   1) A plasticizer having monomeric units from monomers from a substituted vinyl compound characterized by the following formula :

   $$CH_2 = CHR_s$$

   wherein R_s is a methyl group and
   wherein the polymer is characterized by the methyl groups attached to every other asymmetric carbon atom being on the same side of the principal polymer chain and the methyl groups attached to the remaining asymmetric carbon atoms being either on the same side or the opposite side of the methyl groups attached to every other asymmetric carbon atom in the following structure :

   wherein the monomer is propylene and the plasticizer is hemiisotactic polypropylene and

   2) A plastic selected from the group consisting of isotactic polypropylene and syndiotactic polypropylene; wherein the amount of plasticizer is 1-90% by weight.

2. Composition as recited in claim 1 wherein the plastic is syndiotactic polypropylene.

3. Composition as recited in claim 1 wherein the amount of plasticizer is 5-50% by weight.

4. Composition as recited in claim 3 wherein the amout of platicizer is approximatively 10% by weight.

Patentansprüche

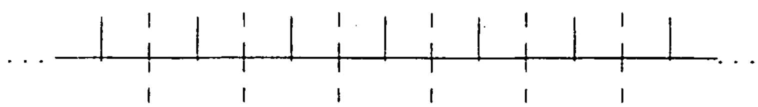
1. Zusammensetzung enthaltend:

   1) einen Weichmacher mit monomeren Einheiten aus Monomeren aus einer substituierten Vinylverbindung,

welche durch die folgende Formel gekennzeichnet ist,

$$CH_2 = CHR_s$$

in welcher R_s eine Methylgruppe ist, und in welcher das Polymer gekennzeichnet ist durch die Methylgruppen, die an jedes zweite der asymmetrischen Kohlenstoffatome gebunden sind, welche sich auf der gleichen Seite der Hauptpolymerkette befinden und durch die Methylgruppen, die an die verbleibenden asymmetrischen Kohlenstoffatome gebunden sind, welche sich entweder auf der gleichen Seite oder auf der entgegengesetzten Seite der Methylgruppen befinden, welche an jedes zweite asymmetrische Kohlenstoffatom in der folgenden Struktur gebunden sind:



in welcher das Monomer aus Propylen besteht und der Weichmacher aus hemiisotaktischem Polypropylen, und

2) einen Kunststoff, der ausgewählt wird aus der Gruppe bestehend aus isotaktischem Polypropylen und syndiotaktischem Polypropylen; in welchem die Menge an Weichmacher 1-90 Gew.% ausmacht.

2. Zusammensetzung gemäß Anspruch 1, in welcher der Kunststoff aus syndiotaktischem Polypropylen besteht.

3. Zusammensetzung gemäß Anspruch 1, in welcher die Menge an Weichmacher 5-50 Gew.% ausmacht.

4. Zusammensetzung gemäß Anspruch 3, in welcher die Menge an Weichmacher ungefähr 10 Gew.% ausmacht.

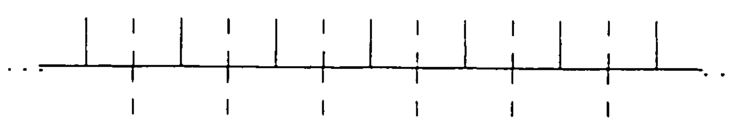
Revendications

1. Composition comprenant:

1) Un plastifiant comportant des unités monomères provenant de monomères d'un composé de vinyle substitué caractérisé par la formule suivante:

$$CH_2 = CHR_s$$

où R_s est un groupe méthyle et où le polymère est caractérisé par des groupes méthyles liés à tout autre atome de carbone asymétrique se trouvant du même côté de la chaîne principale du polymère et les groupes méthyles sont attachés aux restants des atomes de carbone asymétrique se trouvant du même côté ou du côté opposé des groupes méthyles liés à tout autre atome de carbone asymétrique dans la structure suivante:



où le monomère est du propylène et le plastifiant est un polypropylène hémiisotactique et

2) Une matière plastique choisie dans le groupe consistant en polypropylène isotactique et en polypropylène syndiotactique; où la quantité de plastifiant est de 1-90% en poids.

2. Composition selon la revendication 1 dans laquelle la matière plastique est un polypropylène syndiotactique.

3. Composition selon la revendication 1 dans laquelle la quantité de plastifiant est de 5 à 50% en poids.

4. Composition selon la revendication 3 dans laquelle la quantité de plastifiant est d'environ 10% en poids